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ABSTRACT

This study investigated neurological and psychomotor development and intelligence from birth to 8 years of age among Swedish infants with intrauterine growth retardation (IUGR). The relationship between neonatal neurological and behavioral condition to follow-up results was also investigated. Twenty-two infants with IUGR were arranged in 2 groups according to birth weight in relation to gestational age and sex. Control group infants, numbering 17, had normal birth weignt and were born after an uneventful pregnancy. The neonates were examined with a standardized neurological examination largely based on Prechtl's (1977) manual and Brazelton's (1973) Neonatal Behavioral Assessment Scale. At follow-up, a neurological examination and a Griffith's test (1954) were administered at 5, 10, 18 months and at 6 years; Frostig's Developmental Test of Visual Perception (1963) and Stotts' Motor Impairment Test (1972) were administered at 6 years; and the Wechsler Intelligence Scale for Children (1963) and a standardized reading test were administered when the children entered school at 8 years of age. Findings revealed that, in comparison to controls, infants with IUGR exhibited a reduced neurological optimality and poor behavioral responses in the newborn period, and late psychomotor development at school age. Social factors did not seem to affect the findings. Several tables and line charts are included. (RH)

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PSYCHOMOTOR DEVELOPMENT AND SCHOOL PERFORMANCE OF CHILDREN WHO WERE LOW-BIRTH INFANTS. - RELATION TO NEUROBEHAVIOURAL CONDITION IN THE NEWBORN PERIOD

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ABSTRACT

Studies on the prognostic value of neonatal examinations with regard to the development and neurological condition of the infants are few and contradictory. 27 growth retarded infants were compared with a control group of 17 normal infants by use of a modified Perchtl neurological examination and the Brezelton Neonatal Behavioural Assessment Scale (BNBAS) in the neonatal period att full-term age. The growth-retarded infants (birth-weight less than - 2 SD from the mean for gestational age) showed poorer orientation capacity, inferior motor function, and less psychological stability in the BNBAS than the controls. There were no significant differences between the growth-retarded infants and the controls with regard to psychomotor development as assessed by Griffith's test at the age of 5 months, 10 months, 18 months, and 5 years. During the first year at school at 8 years of age, the children were examined by WISC and a reading test was performed. Significant correlations were found between neonatal orientation and motor behaviour and a few Griffith's scales at 18 months and 5 years. No relationship was found between the neurological status in the neonatal period and psychomotor development at follow-up.

PURPOSE

To study the neurological and psychomotor development and intelligence to 8 years of age in infants with intrauteringe growth retardation (IUGR), and the relationship between the neurological and behavioral condition in the neonatal period and the results at follow-up.

MATERIAL

The infants with IUGR were arranged in two groups according to birth-weight in relation to gestational age and sex.

Group 1, infants with severe growth retardation, birth-weight < -2 SD from the mean for gestational age. N=12 (14). Mean birth-weight 2020 ± 324 g.

Group 2, infants with moderate growth retardation, birth-weight between -1 SD and -2 SD from the mean for gestational age. N=10 (15). Mean birth-weight 2675 ± 342 g.

Group 3, (control group); infants with normal birth-weight born after an uneventful pregnancy. N=17 (18). Mean birth-weight 3616 ± 389 g.

Figures in parenthesis are the original number of infants.

The social background measured as the maternal education did not differ significantly between the groups. Smoking habits and maternal lenght did not differ.

METHODS

A. In the newborn period:
The neonates were examined by a standardized neurological examination largely based on the manual of Prechtl (1977). The items were grouped as items evaluating muscle tonus or excitability. A muscel tonus score and an excitability score were deduced (Schulte et al 1971), an optimality score and the total neurological score were calculated as well. The infants were also examined according to the Neonatal Behavioral Assessment Scale (NBAS) (Brazelton 1973).

For statistical purposes the items were arranged in 6 subscales and the score were added together to give a subscale score. Some items were recoded so that high values always represented a better condition than low values (Lester et al). All infants were examined on the 5th day of life. Preterm infants (n=9) were examined when they had reached 40 weeks conceptional age.

B. At the follow-up:

1. A neurological examination was done at 5, 10, 18 months and at 6 years of age. The responses were evaluated as optimal or non-optimal and an optimal neurological score was calculated.

2. A Griffith's test (Griffiths 1954) was performed at home visits of the ages of 5, 10 and 18 months and 6 years by two trained psychologists, who did not know to which group the infant belonged. The developmental age in weeks or months for each subscale were calculated.

3. Frostigs' Developmental Test of Visual Perception (Frostig et al 1963) administered at 6 years of age.

4. Stotts' Motor Impairment Test (Stott et al 1972) administered at 6 years of age.

5. WISC (Wechsler Intelligence Scale for Children (Wechsler 1963) administered at 8 years of age.

6. A standardized reading test for 8-year old children.

RESULTS

I. Comparison between the groups:

A. In the newborn period:

Neurological examination. No abnormalities were seen. Growth-retarded infants showed lower muscle tonus than the controls ($p<0.05$ for both). The most growth-retarded infants showed reduced optimality compared to the controls ($p<0.05$) (Table I).

NBAS. The severely growth-retarded infants showed poorer orientation, inferior motor capacity and less psychological stability than the controls ($p<0.05$ for all) (Table II).

B. Follow-up

1. Neurology. 1 girl in Group 2 developed a spastic diplegia with mental development within the normal limits, she was excluded. 2 children in Group 1 had transient dystonia at 10 months of age. At the 6-year examination 1 boy in Group 1 had minor neurological symptoms (rigidity and clumsiness). 1 child in Group 2 had a moderate deafness. 1 child in Group 1 and 3 in Group 2 showed minor behavioral abnormalities (hyperactivity).

2. Development. The IUGR infants showed poorer results than the controls in the Griffiths' test through all examined ages. The results for 18 months and 5 years are presented in Fig 1 and 2.

3. Frostigs' visual perception test is shown in Fig 3.

4. Stott's test showed the following results (impairment score((Table III).

5,6. WISC and the reading test: The results in stanine points are shown in Fig 4 and 5. The small-for-date children showed lower intelligence quotients than the controls as measured by WISC (Fig 4). The differences between the groups for the reading test were not significant (Fig 5).II.

Correlation between neonatal tests and development

Our neonatal neurological examination did not show any significant correlation to the results of Griffiths' test, Stotts' test or Frostig's test. Deviant muscle tonus in the neonatal period correlated to lower intelligence quotients at 8 years of age in 4 of the 6 WISC Subscales and in 1 of the reading test subscales. Low optimality score correlated to low results in 3 of 6 WISC subscales.

Neonatal Behavioral Assessment:

There were few significant correlations between NBAS subscales and Griffiths' subscales. Orientation correlated with positive coefficients to hearing-speach at 18 months and personal-social and general development at 60 months ($p<0.05$ for all). The motor subscale correlated to performance ($p<0.01$) and general development at 18 months and hearing-speach at 60 months ($p<0.05$ for both).

CONCLUSION

It has been reported on abnormally high incidence of neurological and developmental sequelae at follow-up examinations in small-for-date infants. In the present study children with obvious neurological disturbances or developmental handicap were very few. Infants with IUGR showed, however, a reduced neurological optimality and poor behavioural respones in the newborn period and a late psycomotor development to school age compared to the controls. Social factors did not seem to affect the results.

Few studies on the prognostic value of neonatal neurological and behavioral tests have been reported.

Our results indicate that both tests showed poor correlations to psychomotor development and intelligence to 8 years of age.

IUGR give a rise to high risk for reduced neurological optimality in the newborn period and seems also to be an important factor for the development of the child.

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TABLE 1 Neurological examination

	Group 1	Group 2	Group 3
Muscle tonus score	14,8+1,7	14,7+1,0*	14,1+0,5
Excitability score	14,1+1,5	14,3+0,5	14,2+0,5
Optimality score	24,5+3,5*	25,5+1,8	26,3+1,1
Total score	53,4+4,3	52,4+1,6	51,5+1,3

Different from controls *= $p<0.05$

TABLE II BNBAS

NBAS

The severely growth-retarded infants showed poorer orientation, inferior motor capacity and less psychological stability than the controls ($p<0.05$ for all).

	Group 1	Group 2	Group 3
Habituation	16,2+3,7	16,3+2,8	18,2+3,4
Orientation	34,1+3,5*	37,8+4,5	38,0+5,1
Motor	26,2+2,9*	28,8+3,4	28,5+2,8
Range of state	16,3+1,9	15,3+4,2	16,8+3,0
Regulation of state	17,2+2,6	17,8+2,2	18,4+4,1
Psychological stability	14,4+3,9*	15,1+2,4	16,8+0,4

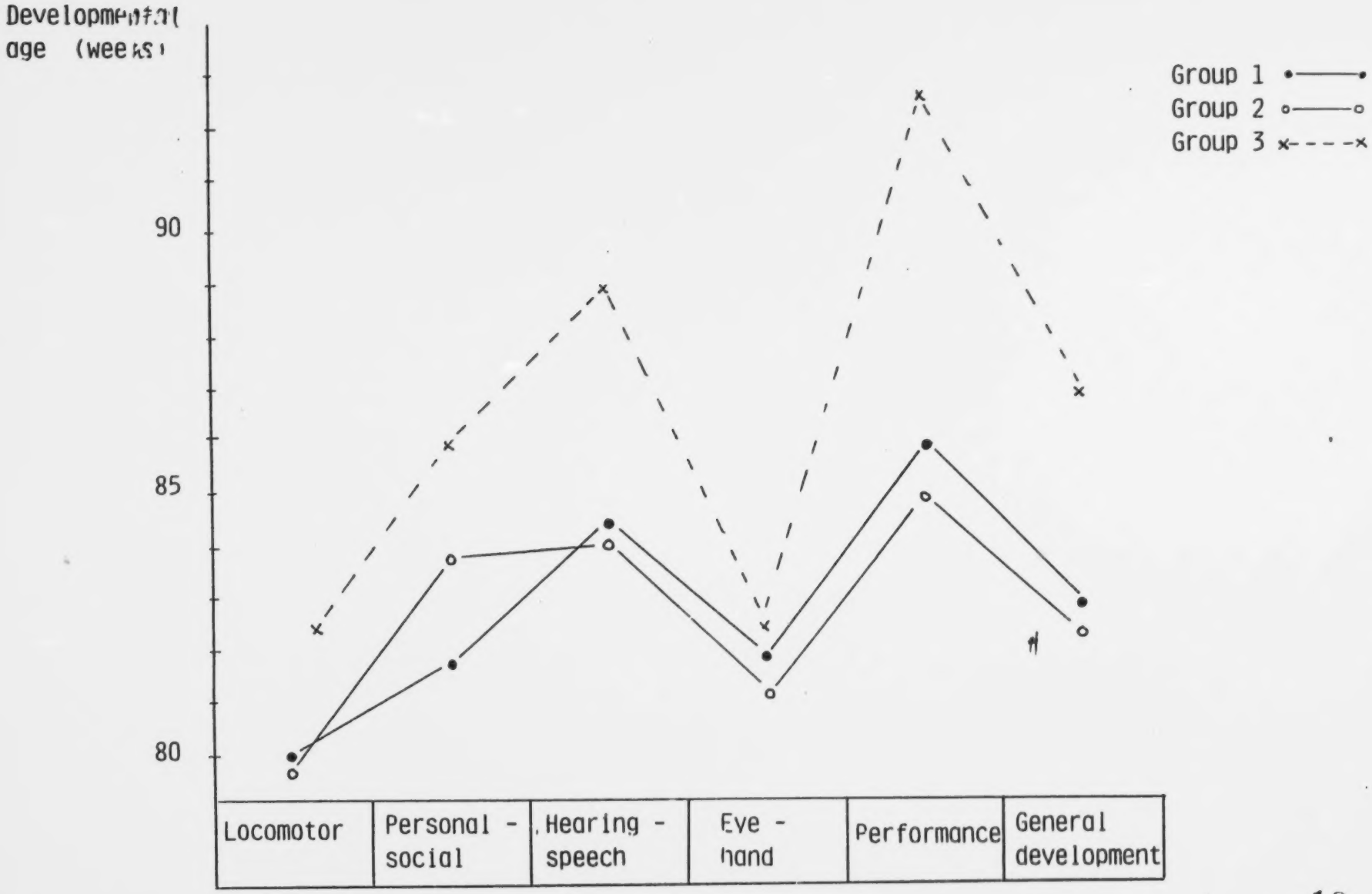
Different from controls *= $p<0.05$

TABLE III Stott's test

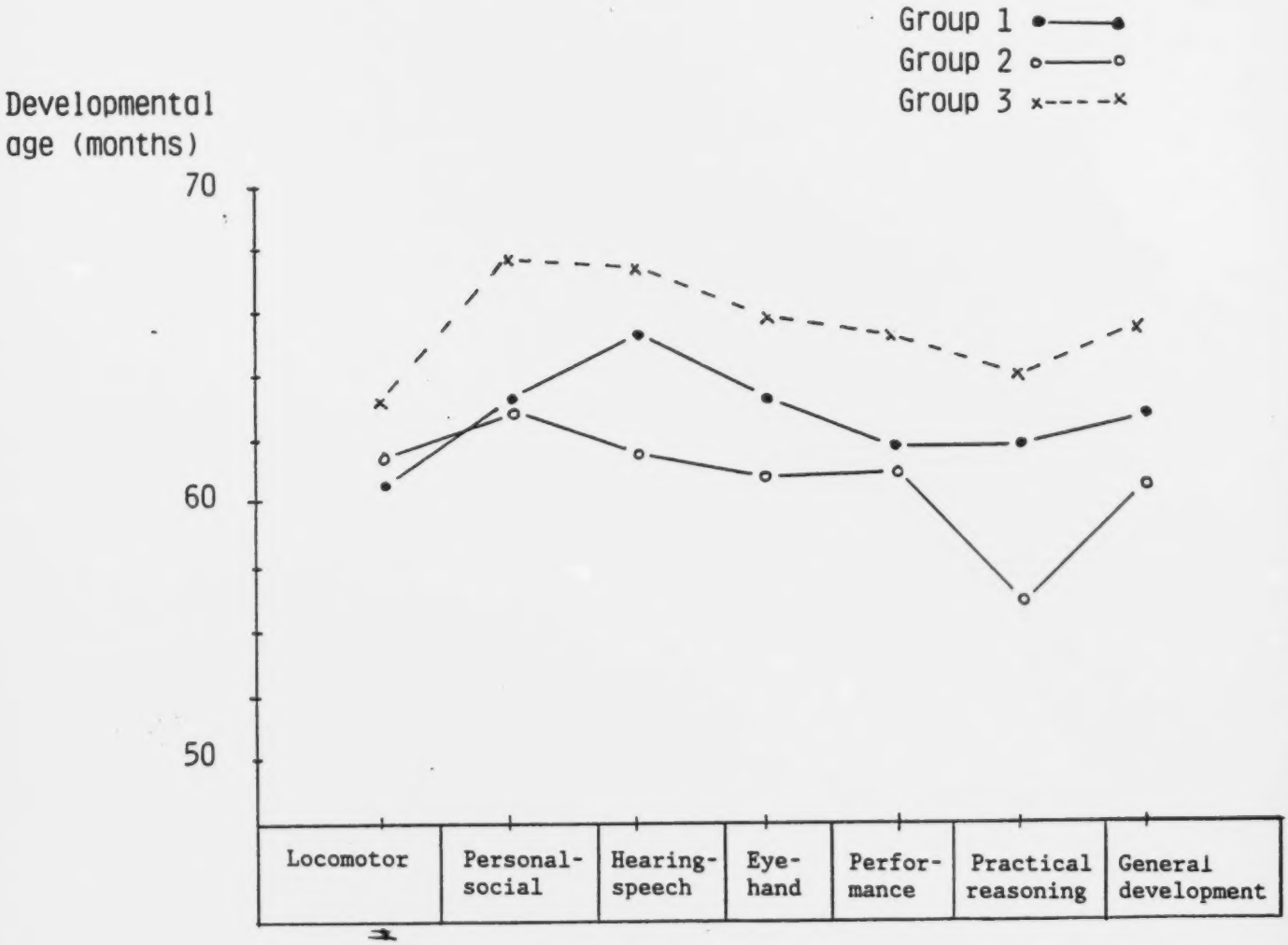
Stotts' test showed the following results (impairment score)

	Group 1	Group 2	Group 3
Score at own age level	3,1	4,2	3,2
Total score	3,4	5,3	3,7

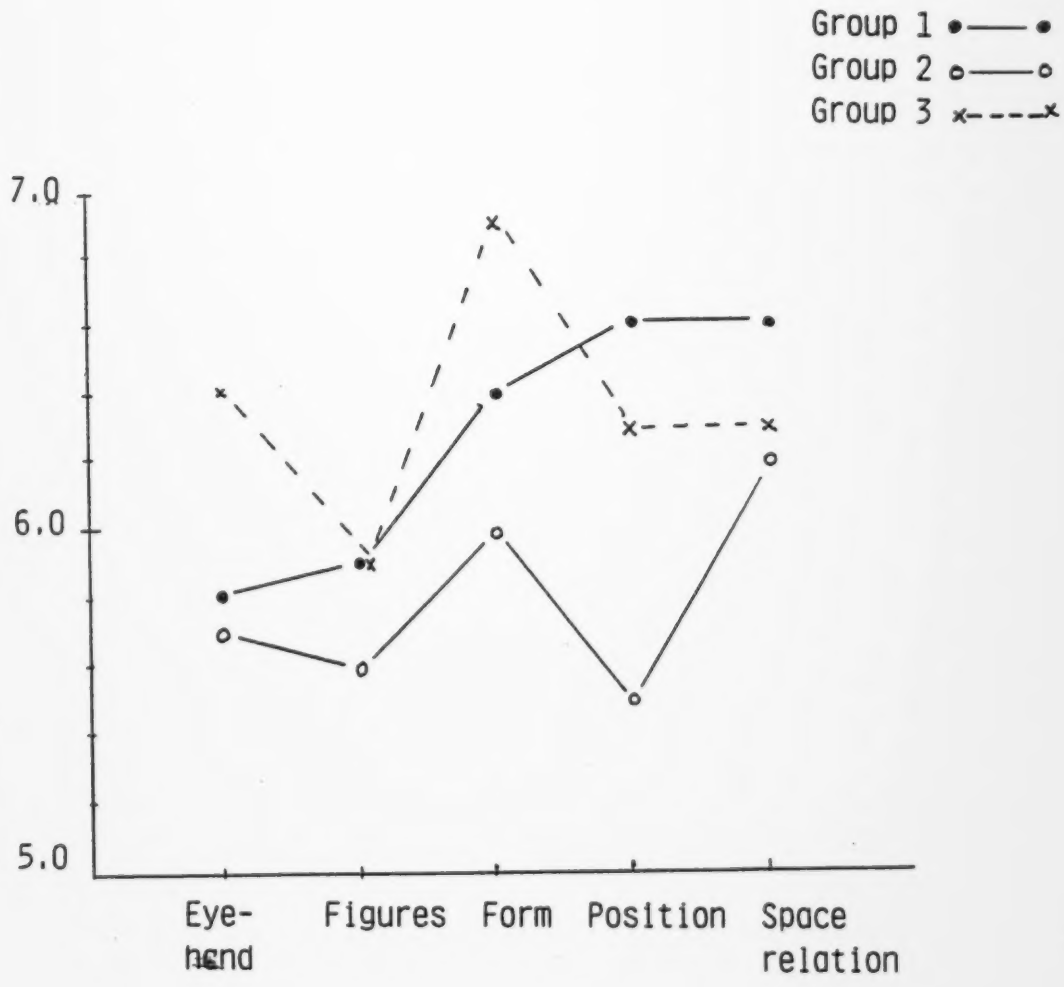
Griffiths' test at 18 months



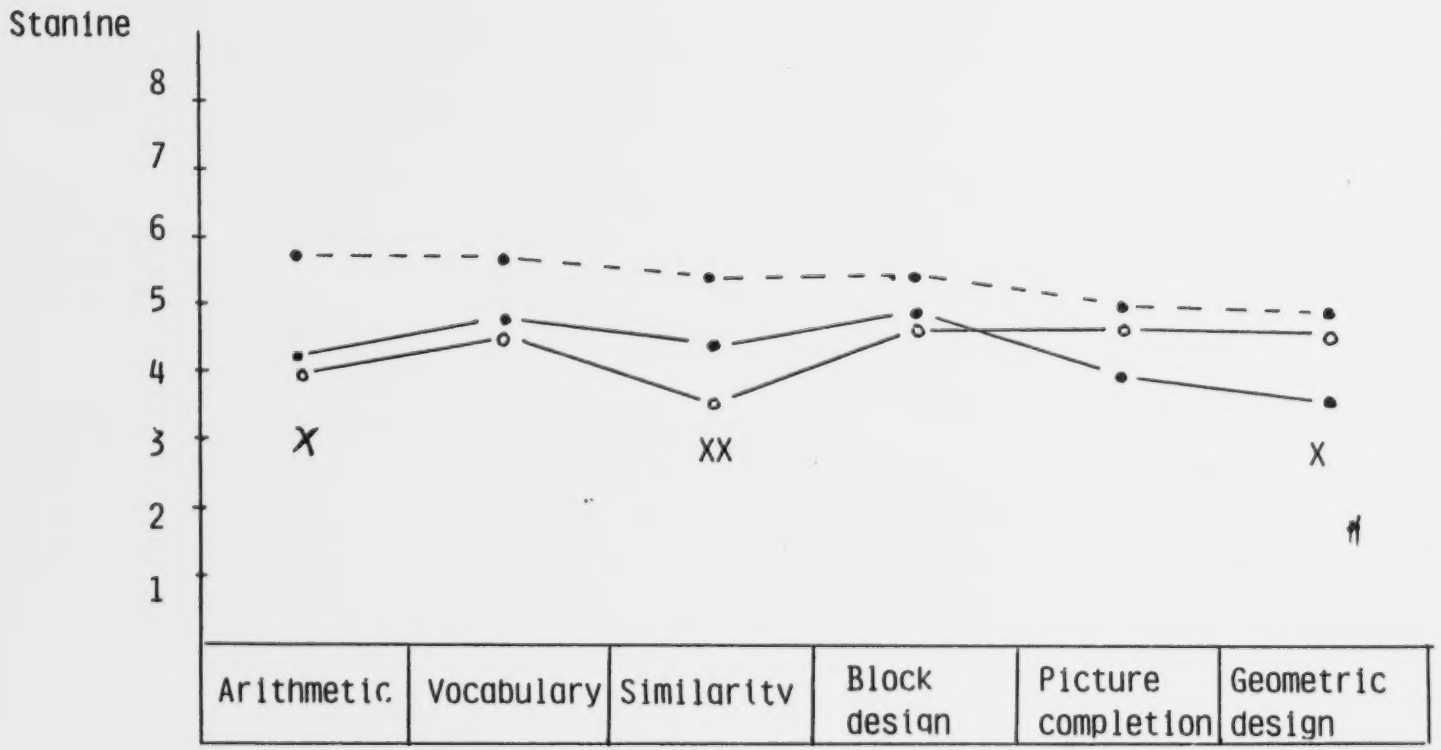
GRIFFITHS' TEST AT 5 YEARS



FROSTIG'S TEST FOR VISUAL PERCEPTION AT 6 YEARS OF AGE



WISC at 8 years



Reading test at 8 years